REMARKS

Claims 1, 2 and 4-24 are pending. Claims 1, 2 and 4-9 are amended and claims 10-24 added. Claim 3 is canceled without prejudice to or disclaimer of the subject matter found therein Further, a substitute specification is provided along with a marked-up copy of the original application. No new matter is added by the substitute specification. Lastly, Fig. 11 is corrected to reverse reference numbers 28 and 29 so that Fig. 11 is in agreement with Figs. 12, 13 and the specification.

It is respectfully requested this Amendment be entered prior to taking the application up for examination. Favorable consideration and prompt allowance of claims 1, 2 and 4-24 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Robert A. Miller
Registration No. 32,771

JAO:RAM/kap

Attachments:
Amended Abstract
Replacement (Fig. 11)
Marked-up Specification
Substitute Specification

Date: October 14, 2004

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

ABSTRACT OF THE DISCLOSURE

~~[Abstract]~~

The air conditioner capacitor is arranged at the front side of the oil cooler or the radiator ~~against~~ relative to the flow of the cooling ~~air, thereby~~air for carrying out maintenance of the oil cooler and/or the radiator at the rear side without removing the air conditioner capacitor arranged at the front side, thus improving maintenance. The turbocharger cooler~~11~~ is structured to change ~~the posture~~its posture ~~so as to swing~~by swinging up and down between ~~the~~ a cooling posture in which the turbocharger cooler~~11~~ is arranged in parallel with the radiator~~8~~ and an open posture in which the turbocharger cooler~~11~~ is arranged such that the front side of the radiator~~8~~ is exposed. The air conditioner capacitor~~10~~ and the oil cooler ~~9~~ are also structured to change ~~the~~ their postures so as to swing horizontally between ~~the~~ a cooling posture in which the air conditioner capacitor~~10~~ and the oil cooler~~9~~ are arranged in parallel with the radiator~~8~~ and an open posture in which the air conditioner capacitor~~10~~ and the oil cooler~~9~~ are arranged such that the front side of the radiator~~8~~ is exposed.

COOLING DEVICE IN A WORK MACHINE

[0001] This application is a U.S. National Stage Application of PCT/JP03/11857 filed September 17, 2003 which claims priority from JP2002-362435 filed December 13, 2002. The disclosures of the two documents in their entireties are incorporated herein by reference thereto.

BACKGROUND OF THE INVENTION

1. Technical Field

[0002] The invention relates to a cooling device in a construction machine such as a hydraulic shovel.

2. Description of Related Art

[0003] Generally a work machine, such as a hydraulic shovel, is provided with a cooling device, such as a radiator, for cooling an engine and an oil cooler for cooling hydraulic fluid. The radiator and oil cooler are generally designed to be cooled with cooling air flowed thereto by rotation of a cooling fan. In this case, the oil cooler and the radiator are arranged to be superposed front and rear relative to the flow of the cooling air (Back To Back (BTB) method) or are arranged to be side to side adjacent to each other (Side By Side (SBS) Method).

[0004] Moreover, recently an increasing number of work machines have an air-conditioning device (air conditioners) installed in order to improve the working environment for the operator. With regards to the cooling of a capacitor for an air conditioner, a construction machine has been known that is structured such that an air conditioner capacitor is provided at the front side of the oil cooler or radiator so that the cooling fan, for cooling the oil cooler and/or the radiator, can also cool the air conditioner capacitor (for example, see Fig. 1 of Japanese Patent Publication No. 3223164).

[0005] Further, it is also known that a work machine in which cooling air from a cooling fan, for cooling the oil cooler and/or the radiator, is used to cool not only the air conditioner capacitor but also compressed air generated by the turbocharger. In this case, the turbocharger cooler and the air conditioner capacitor are arranged on the front face side of the oil cooler while being stacked, one above and adjacent to each other (for example, see Japanese Published Unexamined Patent Application No. 2002-201940).

Summary of the Invention

[0006] In the configuration of the cooling device as disclosed in Japanese Patent Publication No. 3223164, the air conditioner capacitor is fixed to the front face side of the oil

cooler via a fitting. When maintenance, such as inspection and/or repair of the radiator and/or the oil cooler is performed, the air conditioner capacitor arranged on the front face side must be removed. This is troublesome and causes a reduction in work efficiency.

[0007] Further, in the configuration of the cooling device as disclosed in Japanese Published Unexamined Patent Application No. 2002-201940, such that the air conditioner capacitor and the turbocharger cooler are stacked one above the other on the front side of the oil cooler and the radiator, when the cooling device is cleaned, without removing the air conditioner capacitor and the turbocharger cooler, a cleaning worker has to insert a cleaning tool into the space between the cooling device at the front side and the cooling device at the rear side to clean the cooling device while positioned on the upper face of the upper structure, for example. Such a method of cleaning makes it difficult for the cleaning worker to directly and visually observe the core section of the cooling device (particularly the core section of the cooling device arranged at the lower side). This causes a problem in which there is a risk of damaging the cooling core during cleaning. Such problems are intended to be solved by the invention.

[0008] The invention has been made for the purpose of solving the problems. In work machinery in which a plurality of cooling devices, including an air conditioner capacitor are arranged to be superposed front and rear against the flow of the cooling air, the air conditioner capacitor is structured to change the postures between a cooling posture in which the air conditioner capacitor is arranged in parallel with another cooling device and an open posture in which the front side or the rear side of another cooling device is exposed.

[0009] By the configuration as described above, when maintenance such as cleaning, inspection and/or repair of the cooling device is performed, by allowing the air conditioner capacitor to have an open posture, maintenance of other cooling devices can be performed without removing the air conditioner capacitor, thereby improving maintenance work efficiency.

[0010] In the configuration as described above, the air conditioner capacitor and the turbocharger cooler are arranged at the front side or at the rear side of an oil cooler and/or a radiator relative to the flow of the cooling air such that the air conditioner capacitor and the turbocharger cooler are structured to change the postures between the cooling posture in which the air conditioner capacitor and the turbocharger cooler are arranged in parallel with the oil cooler and/or the radiator and an open posture in which the front side or the rear side of the oil cooler and/or the radiator is exposed.

[0011] The air conditioner capacitor and the turbocharger cooler may also be arranged at the front side or at the rear side of an oil cooler and/or a radiator relative to the flow of the cooling air such that the air conditioner capacitor is structured to change posture between the cooling posture in which the air conditioner capacitor is arranged in parallel with the oil cooler and/or the radiator and an open posture in which the front side or the rear side of the oil cooler and/or the radiator is exposed.

[0012] Further, the above-described configuration can be adapted, in a case where the oil cooler and the radiator are arranged side by side and adjacent to each other against the flow of the cooling air and in a case where the oil cooler and the radiator are arranged to be superposed front and rear against the flow of the cooling air. However, in a case where the oil cooler and the radiator are arranged to be superposed front and rear against the flow of the cooling air, the air conditioner capacitor is structured to change posture between the cooling posture in which the oil cooler is arranged in parallel with the radiator and an open posture in which the front side or the rear side of the radiator is exposed, thereby further contributing to improvements in maintenance.

[0013] In the configuration of the cooling device of the invention, the air conditioner capacitor and/or the turbocharger cooler is/are swingably supported by the upper part of the radiator and/or the oil cooler so as to be swing up and down, or the air conditioner capacitor and/or the turbocharger cooler is/are swingably supported by the left and right sides of the radiator or the oil cooler so as to swing back and forth, thereby allowing the turbocharger cooler and/or the air conditioner capacitor to change posture between the cooling posture and the open posture.

[0014] Furthermore, a pipe connected to the air conditioner capacitor and/or the turbocharger cooler can be deformed in accordance with the posture change of the air conditioner capacitor and/or the turbocharger cooler, thereby preventing the pipe from being deteriorated due to the posture change of the turbocharger cooler and/or the air conditioner capacitor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will be described with reference to the drawings, in which:

[0016] Fig. 1 is a plan view showing a hydraulic shovel;

[0017] Fig. 2 is a side view showing the main part of the cooling device having the cooling posture in a first exemplary embodiment;

[0018] Fig. 3 is a side view showing the main part of the cooling device having an open posture in the first exemplary embodiment;

[0019] Fig. 4 is a perspective view showing the main part of the cooling device having an open posture in the first exemplary embodiment;

[0020] Fig. 5 is a perspective view showing the main part of the cooling device having an open posture in the first exemplary embodiment;

[0021] Fig. 6 is a perspective view showing the main part of the cooling device having an open posture in the first exemplary embodiment;

[0022] Fig. 7 is a side view showing the main part of the cooling device having an open posture in a second exemplary embodiment;

[0023] Fig. 8 is a side view showing the main part of the cooling device having an open posture in the second exemplary embodiment;

[0024] Fig. 9 is a perspective view showing the main part of the cooling device having an open posture in the second exemplary embodiment;

[0025] Fig. 10 is a perspective view showing the main part of the cooling device having an open posture in a third exemplary embodiment;

[0026] Fig. 11 is a front view showing the main part of the cooling device having an open posture in a fourth exemplary embodiment;

[0027] Fig. 12 is a front view showing the main part of the cooling device having an open posture in the fourth exemplary embodiment;

[0028] Fig. 13 is a plane view showing the main part of the cooling device having an open posture in the fourth exemplary embodiment; and

[0029] Fig. 14 is a side view showing the main part of the cooling device having an open posture in the fourth exemplary embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] The first exemplary embodiment will be described with reference to Figs. 1-6. In the figures, the reference numeral 1 denotes a hydraulic shovel. The hydraulic shovel 1 (Fig. 1) is composed of a crawler-type lower structure 2, an upper structure 3 rotatably supported by the lower structure 2; and a front attachment 4 attached to the upper structure 3. Further, the upper structure 3 also includes a cab 5 and a counterweight 6 or the like as well as various devices and units, such as an engine 7 (Fig. 2) as a source of power, cooling devices, such as a radiator 8, an oil cooler 9, an air conditioner capacitor 10, and a

turbocharger cooler 11 which will be described later, a hydraulic pump and a valve device (not shown).

[0031] The radiator 8 is a cooling device for cooling the engine 7. The oil cooler 9 is a cooling device for cooling hydraulic fluid and the air conditioner capacitor 10 is a cooling device for cooling and liquefying the cooling medium for cooling. The turbocharger cooler 11 is a cooling device for cooling air compressed by the turbocharger 12 (Fig. 4). The cooling devices 8 to 11 are structured to be cooled by cooling air flowing thereto by the rotation of a cooling fan (not shown) connected to the one end of a crankshaft 7a of the engine 7.

[0032] Among the cooling devices 8 to 11, the radiator 8 is placed at the closest position to the cooling fan (i.e., the most downstream side relative to the flow of the cooling air). Positioned to the front side, and at an upper portion of the radiator 8 (upstream side relative to the flow of the cooling air), is the turbocharger cooler 11. The oil cooler 9 and the air conditioner capacitor 10 are positioned in front of, and at a lower portion, of the radiator. The oil cooler 9 is swingably supported at one of the left or the right side of the radiator 8 via upper and lower hinge members 13 so as to swing back and forth between a cooling posture in which the oil cooler 9 is parallel to the radiator 8, so as to be cooled by the cooling fan, and an open posture in which the oil cooler 9 is swung open to the hinged side so that the lower half of the front face of the radiator 8 is exposed. The air conditioner capacitor 10 is attached to the front face of the oil cooler 9 via the left and right fitting brackets 14 and changes its posture integrally with the oil cooler 9. Furthermore, the turbocharger cooler 11 is swingably supported at the upper front face of the radiator 8 via the left and right hinge members 15 so as to swing up and down. The turbocharger cooler 11 is structured to change posture between a cooling posture in which the turbocharger cooler 11 is positioned parallel to the radiator 8, so as to be cooled by the cooling fan, and an open posture in which the turbocharger cooler 11 is swung upwardly from the cooling posture in so that the upper half of the front face of the radiator 8 is exposed.

[0033] A lock member 16 (Fig. 3) is attached to the fitting bracket 14. The lock member 16 engages with the lock receiving member 17 (Fig. 4) provided at the radiator 8 side, thereby allowing the oil cooler 9 and the air conditioner capacitor 10 to be held at a cooling posture. Further, a shroud 18 encloses the cooling fan to improve the flow of cooling air, thereby increasing the cooling effect.

[0034] Further, the oil cooler 9 is connected with a hydraulic pipe 19 through which hydraulic fluid flows. Because the connection of the hydraulic pipe 19 to the oil cooler 9 is

done via a swivel joint 20, the hydraulic pipe 19 can respond to the swingable posture change of the oil cooler 9 between the cooling posture and the open posture. A hose 21 (Fig. 4) is connected to the air conditioner capacitor 10. The hose 21 is flexible so as to respond to the swingable posture change of the oil cooler 9 integral with the posture change of the air conditioner capacitor 10. Further, the air supply pipe 22, through which air compressed by the turbocharger 12 flows, is connected to the turbocharger cooler 11. The air supply pipe 22 has a section arranged on the upper part of the shroud 18 and the radiator 8 has a bellows-like shape so as to respond to the posture change of the turbocharger cooler 11 between the cooling posture and the open posture.

[0035] In the configuration of the first exemplary embodiment as described above, the radiator 8, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11 are cooled by cooling air flowing thereto due to the rotation of the cooling fan. In this case, the oil cooler 9 and the turbocharger cooler 11, arranged at the front side of the radiator 8, can change their posture between the cooling posture in which the oil cooler 9 and the turbocharger cooler 11 are arranged in parallel with the radiator 8 and the open posture in which the front face side of the radiator 8 is exposed. The air conditioner capacitor 10, at the front side of the oil cooler 9, changes its posture with the posture change of the oil cooler 9 as they are integrated.

[0036] As a result, although the radiator 8, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11 are arranged to be superposed from front to rear with respect to the flow of the cooling air, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11, arranged at the front side of the radiator are held at an open posture, thereby making it possible to carry out maintenance, such as cleaning, inspection, and/or repair of the radiator 8. Maintenance of the oil cooler 9, arranged between the radiator 8 and the air conditioner capacitor 10, also can be performed by allowing the oil cooler 9 to be held at an open posture so that the rear face side of the oil cooler 9 is exposed. As such, maintenance of the cooling device can be performed without removing the cooling device, thereby improving workability in maintenance.

[0037] Additionally, the invention is not limited to the first exemplary embodiment. For example, the second exemplary embodiment, shown in Figs. 7-9, in contrast to the first exemplary embodiment, of the invention is adapted to a configuration in which the oil cooler 9 is large sized and the turbocharger cooler 11 and the air conditioner capacitor 10 are arranged in a stacked (up and down) relationship at the front side of the oil cooler 9.

[0038] In describing the second, third and fourth exemplary embodiments, components identical to those in the first exemplary embodiment are provided with the same reference numerals.

[0039] The configurations shown in the first and second exemplary embodiments are the Back To Back (BTB) type in which the oil cooler 9 and the radiator 8 are arranged to be superposed front and rear relative to the flow of the cooling air. However, the invention also can be adapted to a configuration of the Side By Side (SBS) type, as shown in the third exemplary embodiment shown in Fig. 10 and the fourth exemplary embodiment shown in Figs. 11-14 in which the oil cooler 9 and the radiator 8 are arranged adjacent to each other in a side by side relationship.

[0040] In the configuration shown in the third and fourth exemplary embodiments, on the front side of the oil cooler 9 and the radiator 8, that are arranged to be adjacent to each other in a side by side relationship, the turbocharger cooler 11 is arranged at the upper part and the air conditioner capacitor 10 is arranged at the lower part of the adjacent oil cooler 9 and radiator 8. However, in the configuration of the third exemplary embodiment, the turbocharger cooler 11 is swingably supported at the upper portion of the oil cooler 9 and the radiator 8 so as to swing up and down and is structured to change posture between the cooling posture and the open posture. On the other hand, the air conditioner capacitor 10 is supported at the side by the oil cooler 9 so as to swing horizontally and is structured to change the posture between the cooling posture and the open posture.

[0041] In the configuration shown in the third exemplary embodiment, maintenance, such as cleaning, inspection, and/or repair of the oil cooler 9 and the radiator 8, can be performed by holding the air conditioner capacitor 10 and the turbocharger cooler 11, arranged at the front side of the oil cooler 9 and the radiator 8, at an open posture.

[0042] The fourth exemplary embodiment is configured such that only the air conditioner capacitor 10 changes its posture between the cooling posture and the open posture. Specifically, in the configuration shown in the fourth exemplary embodiment, the turbocharger cooler 11 is bolted to the front face of the case frame 23, in which the oil cooler 9 and the radiator 8 are assembled, via the left and right fitting brackets 24. In this case, an appropriate space S (Fig. 14) is provided between the turbocharger cooler 11, the oil cooler 9 and the radiator 8, through which a cleaning worker can visually observe the core sections of the cooling devices 8, 9, 11 from the lower side of the turbocharger cooler 11. In Figs. 11-14, an air supply pipe 25 is connected to the turbocharger cooler 11. However, because in the

fourth exemplary embodiment, the turbocharger cooler 11 does not change its posture, the air supply pipe 25 is not required to deform. Therefore, configuration of the fourth exemplary embodiment differs from the configurations in the first through third exemplary embodiments, and can use a conventional general-purpose air supply pipe 25.

[0043] On the other hand, in the configuration of the fourth exemplary embodiment, the air conditioner capacitor 10 is supported by and fixed to a square frame-like support member 26 and a pair of upper and lower hinges 27 are attached to one side of the support member 26 at the side opposite to the air supply pipe 25. Fixed at the left side of the case frame 23, in which the oil cooler 9 and the radiator 8 are assembled, is a first support bracket 28 that protrudes in the frontward direction. A second support bracket 29 that protrudes in the right direction is fixed at the first support bracket 28,. The pair of hinges 27 are attached to the second support bracket 29 at the other side so that the support member 26 can be pivotably swung back and forth around the pin shafts of the hinges 27. As a result, the air conditioner capacitor 10 is structured to change its posture integrally with the support member 26 between the cooling posture in which the air conditioner capacitor 10 is arranged in parallel with the radiator 8 and the oil cooler 9, for cooling by the cooling fan, and an open posture in which the air conditioner capacitor 10 is swung from the cooling posture to the side so that the front face lower halves of the radiator 8 and the oil cooler 9 are exposed.

[0044] A pipe 30, through which the cooling medium flows, is connected to the left side of the air conditioner capacitor 10. The end of the pipe 30 to which the air conditioner capacitor 10 is connected is composed of a steel pipe 30a. A flexible hose 30b is connected to the tip end of the steel pipe 30a to enable the above-described posture change of the air conditioner capacitor 10. The steel pipe 30a is designed to slightly project from the left end of the air conditioner capacitor 10 to the left outside and to bend forward, thereby preventing the pipe 30 from interfering with other members, such as the hinges 27 and the second support bracket 29, when the air conditioner capacitor 10 moves to and is in the open posture.

[0045] In Figs. 11-14, a latching device 31, with a handle 31a, is provided at the right side of the support member 26. A latch receiving fixture 32 is provided at a third support bracket 33 fixed to the right side part of the case frame 23 so as to be engageably locked by the latching device 31, thereby holding the air conditioner capacitor 10 at a cooling posture, and, at the same time, allowing an operator to swing the air conditioner capacitor 10 with a light control force.

[0046] In the configuration of the fourth exemplary embodiment as described above, the oil cooler 9 and the radiator 8 are arranged side by side and adjacent to each other at the front side of the oil cooler 9 and radiator 8. The turbocharger cooler 11 is placed at the upper portion and the air conditioner capacitor 10 is placed at the lower portion of the oil cooler 9 and the radiator 8.

[0047] When the cooling device in this configuration is cleaned, the air conditioner capacitor 10 is allowed to be held at an open posture, thereby the rear face side of the air conditioner capacitor 10, and the front face lower halves of the oil cooler 9 and of the radiator 8 are exposed. Thus, the parts can be easily cleaned. On the other hand, as described above, provided between the turbocharger cooler 11 and the oil cooler 9 and the radiator 8, is the space S through which a cleaning worker can visually observe the core section of the cooling devices from the lower part of the turbocharger cooler 11. As a result, the cleaning worker, standing at ground level, can visually observe from the lower side the core section of the cooling device by holding the air conditioner capacitor 10, arranged at the lower side of the turbocharger cooler 11, at the open posture. Thus, the cooling devices can be cleaned easily without damaging the core section, thus improving workability.

[0048] Additionally, in the configuration of the fourth exemplary embodiment, only the air conditioner capacitor 10, among the cooling devices provided at the front side of the oil cooler 9 and the radiator 8, is structured to change its posture between the cooling posture and the open posture. The turbocharger cooler 11 is fixed in position. Thus, when repair of the oil cooler 9 and the radiator 8 is performed, the turbocharger cooler 11 must be removed. But in case of a work machine, such as a hydraulic shovel, which works at a work site with lots of dust, cleaning of the cooling devices must be performed frequently. In the fourth exemplary embodiment, the cleaning can be performed without removing the turbocharger cooler 11 while observing the core section.

[0049] Further in the fourth exemplary embodiment, the air conditioner capacitor 10, which is arranged at the lower portion of the cooling devices, arranged adjacent to each other at the upper and lower portions, is structured to change its posture. Thus, by allowing the air conditioner capacitor 10 to be held at an open posture, an operator responsible for cleaning the cooling devices can visually observe the appropriate space S between the turbocharger cooler 11 and the oil cooler 9 and the radiator 8 from the lower side. Thus, a cleaning worker can clean the cooling devices from ground level (or standing on the crawler upper face in the case of a large work machine), avoiding the difficulty, such as climbing on

the upper face of the upper rotating body 3 to clean the cooling device, thus contributing to improvements in workability.

[0050] Further, the invention can also be adapted to a configuration in which only the air conditioner capacitor is arranged at the front side or at the rear side of the radiator and/or the oil cooler or a configuration in which the air conditioner capacitor and the turbocharger cooler are arranged to be superposed front and rear, for example.

[0051] As described above, a cooling device in a work machine according to the invention can be effectively used for cooling devices, including an oil cooler and a radiator, that are arranged in the Back To Back (BTB) or the Side By Side (SBS) methods in a work machine, such as a hydraulic shovel. More specifically, the cooling device of the invention is particularly suitable for cooling devices in which the air conditioner capacitor or the turbocharger cooler is arranged at the front side of the radiator and/or the oil cooler.

WORKING PAPERS

This application is a U.S. National Stage Application of PCT/JP03/11857 filed September 17, 2003 and which claims priority from JP 2002-362435 filed December 13, 2002. The disclosures of the two documents in their entireties are incorporated herein by reference thereto.

Center, all caps

10/511138

DT04 Rec'd PCT/PTO 14 OCT 2004

~~[Specification]~~

Cooling Device in a ~~Construction~~ Work Machine

~~Background of the Invention~~ Technical Field

¶1

The present invention relates to a cooling device in a construction machine such as a hydraulic shovel.

~~[Background of the Invention]~~ Description of Related Art

¶2

Generally a construction machine, such as a hydraulic shovel, is provided with a cooling device, such as a radiator, for cooling an engine and an oil cooler for cooling hydraulic fluid. The radiator and oil cooler are generally designed to be cooled with cooling air flow~~ing~~ed thereto by rotation of a cooling fan. In this case, the oil cooler and the radiator are arranged to be superposed ~~back~~ front and ~~forth against~~ rear relative to the flow of the cooling air (Back To Back (BTB) method) or are arranged to be side by side adjacent to each other ~~from side to side~~ (Side By Side (SBS) Method).

Moreover, recently an increasing number of construction machines have ~~been installed with~~ installed an air-conditioning device (air conditioners) in order to improve the working environment ~~of an~~ for the operator. With regards to the cooling of a capacitor for an air conditioner, a construction machine has been known that is structured such that an air conditioner capacitor is provided at the front side of the oil cooler or radiator so that the cooling fan for cooling the oil cooler and/or the radiator can also cool the air conditioner capacitor (for example, see Fig. 1 of Japanese Patent Publication No. 3223164).

Further, it is also known that a construction machine in which cooling air from a cooling fan for cooling the oil cooler and/or

the radiator, is used to cool not only the air conditioner capacitor but also compressed air generated by the turbocharger. In this case, the turbocharger cooler and the air conditioner capacitor are arranged on the front face side of the oil cooler while being adjacent to each other ~~up and down~~ (for example, see Japanese Published Unexamined Patent Application No. 2002-201940).

~~[Disclosure of the Invention]~~

In the configuration of the cooling device as disclosed in Japanese Patent Publication No. 3223164, the air conditioner capacitor is fixed to the front face side of the oil cooler via a fitting. When maintenance, such as inspection and repair of the radiator and/or the oil cooler is performed, the air conditioner capacitor arranged on the front face side must be removed. This is troublesome and causes a reduction in ~~workability~~.

Further, in the configuration of the cooling device as disclosed in Japanese Published Unexamined Patent Application No. 2002-201940, such that the air conditioner capacitor and the turbocharger cooler are ~~arranged up and down~~ on the front side of the oil cooler and the radiator, ~~in a case where~~ the cooling device ~~in this configuration~~ is cleaned, without removing the air conditioner capacitor and the turbocharger cooler, ~~arranged on the front side,~~ a cleaning worker has to insert a cleaning tool into the space between the cooling device at the front side and the cooling device at the rear side to clean the cooling device while ~~riding~~ on the upper face of the upper structure, for example. Such a method of cleaning makes it difficult for the cleaning worker to directly and visually observe the core section of the cooling device

(particularly the core section of the cooling device arranged at the lower side). This causes a problem in which there is a risk of damaging the cooling core during cleaning. Such problems are intended to be solved by the ~~present~~ invention.

The ~~present~~ invention has been made in view ~~of the above present condition~~ for the purpose of solving the~~se~~ problems. In construction machinery in which a plurality of cooling devices including an air conditioner capacitor are arranged to be superposed front and rear ~~back and forth~~ against the flow of the cooling air, the air conditioner capacitor is structured to change the postures between a cooling posture in which the air conditioner capacitor is arranged in parallel with another cooling device and an open posture in which the front side or the rear side of another cooling device is exposed.

By the configuration as described above, when maintenance such as cleaning, inspection and/or repair of the cooling device is performed, by allowing the air conditioner capacitor to have an open posture, maintenance of ~~a~~another cooling devices can be performed without removing the air conditioner capacitor, thereby improving ~~workability in~~ maintenance work efficiency.

In the configuration as described above, the air conditioner capacitor and the turbocharger cooler are arranged at the front side or at the rear side of an oil cooler and/or a radiator relative to ~~against~~ the flow of the cooling air such that the air conditioner capacitor and the turbocharger cooler are structured to change the postures between the cooling posture in which the air conditioner capacitor and the turbocharger cooler are arranged in parallel with the oil cooler and/or the radiator and an open posture in which the front

side or the rear side of the oil cooler and/or the radiator is exposed.

The air conditioner capacitor and the turbocharger cooler may also be arranged at the front side or at the rear side of an oil cooler and/or a radiator ~~against~~ relative to the flow of the cooling air such that the air conditioner capacitor is structured to change ~~the posture~~ posture between the cooling posture in which the air conditioner capacitor is arranged in parallel with the oil cooler and/or the radiator and an open posture in which the front side or the rear side of the oil cooler and/or the radiator is exposed.

Further, the above-described configuration can be adapted, in a case where the oil cooler and the radiator are arranged side by side and adjacent to each other ~~from side to side~~ against the flow of the cooling air and in a case where the oil cooler and the radiator are arranged to be superposed ~~back~~ front and ~~forth~~ rear against the flow of the cooling air. however, in a case where the oil cooler and the radiator are arranged to be superposed ~~back~~ front and ~~forth~~ rear against the flow of the cooling air, the air conditioner capacitor is structured to change the ~~postures~~ posture between the cooling posture in which the oil cooler is arranged in parallel with the radiator and an open posture in which the front side or the rear side of the radiator is exposed, thereby further contributing to improvements in maintenance.

In the configuration of the cooling device of the ~~present~~ invention, the air conditioner capacitor and/or the turbocharger cooler is/are swingably supported by the upper part of the radiator and/or the oil cooler so as to be swing up and down, or the air conditioner capacitor and/or the turbocharger cooler is/are

swingably supported by the left and right sides of the radiator or the oil cooler so as to swing back and forth, thereby allowing the turbocharger cooler and/or the air conditioner capacitor to change the ~~postures~~ posture between the cooling posture and the open posture.

Furthermore, a pipe connected to the air conditioner capacitor and/or the turbocharger cooler can be deformed in accordance with the posture change of the air conditioner capacitor and/or the turbocharger cooler, thereby preventing the pipe from being deteriorated due to the posture change of the turbocharger cooler and/or the air conditioner capacitor.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the drawings in which:

Fig. 1 is a plane view showing a hydraulic shovel;

Fig. 2 is a side view showing the main part of the cooling device having the cooling posture in ~~the~~ a first exemplary Embodiment;

Fig. 3 is a side view showing the main part of the cooling device having an open posture in the first exemplary Embodiment;

Fig. 4 is a perspective view showing the main part of the cooling device ~~1~~ having an open posture in the first exemplary Embodiment;

Fig. 5 is a perspective view showing the main part of the cooling device ~~1~~ having an open posture in the first exemplary Embodiment;

Fig. 6 is a perspective view showing the main part of the cooling device ~~1~~ having an open posture in the first exemplary Embodiment;

Fig. 7 is a side view showing the main part of the cooling device ~~1~~ having an open posture in ~~the~~ a second exemplary Embodiment;

Fig. 8 is a side view showing the main part of the cooling device ~~1~~ having an open posture in the second exemplary Embodiment;

Fig. 9 is a perspective view showing the main part of the cooling device ~~1~~ having an open posture in the second exemplary Embodiment;

Fig. 10 is a perspective view showing the main part of the cooling device ~~1~~ having an open posture in ~~the~~ a third exemplary Embodiment;

Fig. 11 is a front view showing the main part of the cooling device ~~1~~ having an open posture in ~~the~~ a fourth exemplary Embodiment;

Fig. 12 is a front view showing the main part of the cooling device ~~1~~ having an open posture in the fourth exemplary Embodiment;

Fig. 13 is a plane view showing the main part of the cooling device ~~1~~ having an open posture in the fourth exemplary Embodiment; and

Fig. 14 is a side view showing the main part of the cooling device ~~1~~ having an open posture in the fourth exemplary Embodiment.

DETAILED DESCRIPTION of THE PREFERRED EMBODIMENTS ~~[Best Mode for Carrying Out the Invention]~~

The first exemplary embodiment ~~of the present invention~~ will be described with reference to Fig. 1 ~~to Fig.~~ 6. In the figures, the reference numeral 1 (Fig. 1) denotes a hydraulic shovel. The hydraulic shovel 1 is composed of a crawler-type lower structure 2, an upper structure 3 rotatably supported by the lower structure 2; and a front attachment 4 attached to the upper structure 3. Further, the upper structure 3 also includes a cab 5 and a counterweight 6 or the like as well as various devices and units such as an engine 7 (Fig. 2) as a source of power, cooling devices such as a radiator 8, an oil cooler 9, an air conditioner capacitor 10, and a turbocharger cooler 11 which will be described later, a hydraulic pump and a valve device (not shown).

The radiator 8 is a cooling device for cooling the engine 7. The oil cooler 9 is a cooling device for cooling hydraulic fluid

and the air conditioner capacitor 10 is a cooling device for cooling and liquefying the cooling medium for cooling. The turbocharger cooler 11 is a cooling device for cooling air compressed by the turbocharger 12 (Fig. 4). These cooling devices 8 to 11 are structured to be cooled by cooling air flowing thereto by the rotation of a cooling fan (not shown) connected to the one end of a crankshaft 7a of the engine 7.

Among the cooling devices 8 to 11, the radiator 8 is placed at the closest position to the cooling fan (i.e., the most downstream position relative to the flow of the cooling air), and at the front side, and at an upper portion of the radiator 8 (upstream side relative to the flow of the cooling air), is the turbocharger cooler 11, ~~is positioned in the upward direction and~~ the oil cooler 9 and the air conditioner capacitor 10 are positioned in front of and at a lower portion of the radiator ~~in the lower direction~~. The oil cooler 9 is swingably supported at one ~~side~~ of the left ~~side~~ or the right side of the radiator 8 via ~~the~~ upper and lower hinge members 13 so as to swing back and forth, ~~whereby enabling it to change the postures~~ between a cooling posture in which the oil cooler 9 is ~~arranged in~~ parallel to ~~with~~ the radiator 8, so as to be cooled by the cooling fan, and an open ~~posture~~ in which the oil cooler 9 is swung open to the ~~front side~~ so that the lower half of the front face of the radiator 8 is exposed. The air conditioner capacitor 10 is attached to the front face of the oil cooler 9 via the left and right fitting brackets 14 and ~~is structured to~~ change its ~~the~~ postures integrally with the oil cooler 9. Furthermore, the turbocharger cooler 11 is swingably supported at the upper front face of the radiator 8 via the left and right hinge members 15 so as to swing up and down, and is structured the turbocharger cooler 11

to change ~~the~~ postures between a cooling posture in which the turbocharger cooler 11 is ~~arranged in~~ positioned parallel ~~with~~ to the radiator 8 so as to be cooled by the cooling fan and an open posture in which the turbocharger cooler 11 is swung upwardly from the cooling posture in ~~the upward direction~~ so that the ~~lower~~ upper half of the front face of the radiator 8 is exposed.

~~The reference numeral 16 denotes~~ a lock member 16 (Fig.3) attached to the fitting bracket 14. The lock member 16 engages with the lock receiving member 17 (Fig.4) provided at the radiator 8 side, thereby allowing the oil cooler 9 and the air conditioner capacitor 10 to be held at a cooling posture. Further, ~~the reference numeral 18 denotes~~ a shroud 18 enclosing the cooling fan, ~~which is~~ to improve the flow of cooling air, thereby increasing the cooling effect.

Furthermore, the oil cooler 9 is connected with a hydraulic pipe 19 through which hydraulic fluid flows. Because the connection of the hydraulic pipe 19 to the oil cooler 9 is done via a swivel joint 20, the hydraulic pipe 19 can respond to the swingable posture change of the oil cooler 9 between the cooling posture and the open posture. A hose 21 (Fig.4) is connected to the air conditioner capacitor 10, ~~and~~ the hose 21 ~~has flexibility~~ is flexible so as to respond to the swingable posture change of the oil cooler 9 integrally with the posture change of the air conditioner capacitor 10. Further, the air supply pipe 22 through which air compressed by the turbocharger 12 flows, is connected to the turbocharger cooler 11, ~~and~~ The air supply pipe 22 has a section arranged on the upper part of the shroud 18 and the radiator 8 ~~in~~ has a bellows-like shape so as to respond to the posture change of the turbocharger cooler 11 between the cooling posture and the open posture.

In the configuration of the exemplary first embodiment as described above, the radiator 8, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11 are cooled by cooling air flowing thereto due to the rotation of the cooling fan. In this case, the oil cooler 9 and the turbocharger cooler 11, arranged at the front side of the radiator 8, can change their postures between the cooling posture in which the oil cooler 9 and the turbocharger cooler 11 are arranged in parallel with the radiator 8 and the open posture in which the front face side of the radiator 8 is exposed. The air conditioner capacitor 10, as it is integrated with the posture change of the oil cooler 9, changes its posture as they are integrated.

As a result, although the radiator 8, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11 are arranged to be superposed from front to rear with respect to the flow of the cooling air, the oil cooler 9, the air conditioner capacitor 10, and the turbocharger cooler 11, arranged at the front side of the radiator, are held at an open posture, thereby making it possible to carry out maintenance, such as cleaning, inspection, or repair of the radiator 8. Maintenance of the oil cooler 9, arranged between the radiator 8 and the air conditioner capacitor 10, also can be performed by allowing the oil cooler 9 to be held at an open posture so that the rear face side of the oil cooler 9 is exposed. As such, maintenance of the cooling device can be performed without removing the cooling device, thereby improving workability in maintenance.

Additionally, the invention is not limited to the first

embodiment. ~~of the present invention.~~ For example, ~~as~~ the second embodiment, shown in Fig. 7 ~~through Fig. 9~~, ~~as well as~~ the first embodiment, the ~~present~~ invention ~~also can be~~ adapted to ~~the~~ configuration in which the oil cooler 9 is large sized and the turbocharger cooler 11 and the air conditioner capacitor 10 are arranged up and down at the front side of the oil cooler 9.

The configurations shown in the first and second embodiments are the Back To Back (BTB) type in which the oil cooler 9 and the radiator 8 are arranged to be superposed ~~back~~ and ~~forth against~~ the flow of the cooling air. however, the ~~present~~ invention also can be adapted to a configuration of the Side By Side (SBS) type, as shown in the third embodiment shown in Fig. 10 and the fourth embodiment shown in Fig. 11 ~~through Fig. 14~~ in which the oil cooler 9 and the radiator 8 are arranged adjacent to each other ~~at the left and right sides~~.

In the configuration shown in the third and fourth embodiments, on the front side of the oil cooler 9 and the radiator 8 that are arranged to be adjacent to each other ~~at left and right sides~~, the turbocharger cooler 11 is arranged at the upper part and the air conditioner capacitor 10 is arranged at the lower part. However, in the configuration of the third embodiment, the turbocharger cooler 11 is swingably supported ~~by~~ the oil cooler 9 and the radiator 8 so as to swing up and down and is structured to change ~~the~~ posture between the cooling posture and the open posture. On the other hand, the air conditioner capacitor 10 is supported by the oil cooler 9 so as to swing horizontally and is structured to change the posture between the cooling posture and the open posture.

In the configuration shown in the exemplary third embodiment, maintenance such as cleaning, inspection, and/or repair of the oil cooler 9 and the radiator 8, ~~arranged at the rear side~~ can be performed by holding ~~allowing~~ the air conditioner capacitor 10 and the turbocharger cooler 11, arranged at the front side, of the oil cooler 9 and the radiator 8, ~~to be held~~ at an open posture.

~~Further, in~~ the exemplary fourth embodiment, ~~it~~ is configured such that only the air conditioner capacitor 10 changes its ~~the~~ posture between the cooling posture and the open posture.

Specifically, in the configuration shown in the exemplary fourth embodiment, the turbocharger cooler 11 is bolted to the front face of the case frame 23, in which the oil cooler 9 and the radiator 8 are assembled, via the left and right fitting brackets 24. In this case, between the turbocharger cooler 11, the oil cooler 9 and the radiator 8, an appropriate space S (Fig. 14) is provided through which a cleaning worker can visually observe the core sections of the cooling devices 8, 9, ~~and~~ 11 from the lower side ~~direction~~ of the turbocharger cooler 11. ~~is secured.~~ In Fig. 11 ~~to Fig.~~ 14, ~~the reference numeral 25 denotes~~ an air supply pipe 25 is connected to the turbocharger cooler 11. however, because in the exemplary fourth embodiment, ~~it is structured so that~~ the turbocharger cooler 11 does not change its ~~the~~ posture, ~~thus~~ the air supply pipe 25 is not required to deform. Therefore, the configuration of the exemplary fourth embodiment differs from the configurations in the first through third exemplary embodiments, and can use a ~~thereby using the~~ conventional general-purpose air supply pipe 25.

On the other hand, in the configuration of the exemplary fourth embodiment, the air conditioner capacitor 10 is supported by and fixed to a square frame-like support member 26 and a pair of upper and lower

hinge 27 are attached to ~~the left end section~~ of the support member 26 at the one side. At the left side of the case frame 23, in which the oil cooler 9 and the radiator 8 are assembled, a first support bracket 28 protruding in the frontward direction ~~is fixed~~. At the first support bracket 28, ~~the~~ second support bracket 29 protruding in the right direction is fixed. ~~And~~ the pair of hinges 27 are attached to the second support bracket 29 at the other side so that the support member 26 can be pivotably swung back and forth around the pin shaft of the hinge 27. As a result, the air conditioner capacitor 10 is structured to change ~~the~~ posture integrally with the support member 26 between the cooling posture in which the air conditioner capacitor 10 is arranged in parallel with the radiator 8 and the oil cooler 9, ~~so as to be~~ cooled by the cooling fan, and an open posture in which the air conditioner capacitor 10 is swung from the cooling posture to the ~~front~~ side so that the front face lower halves of the radiator 8 and the oil cooler 9 are ~~opened~~.

~~The~~ pipe 30, through which the cooling medium flows, is connected to the left ~~end~~ of the air conditioner capacitor 10. ~~and~~ the ~~one~~ ~~side~~ of the pipe 30 to which the air conditioner capacitor 10 is connected is composed of a steel pipe 30a. A flexible hose 30b is connected to the tip end of the steel pipe 30a ~~so as~~ to ~~respond to~~ the above-described posture change of the air conditioner capacitor 10. The ~~above~~ steel pipe 30a is designed to slightly project from the left end of the air conditioner capacitor 10 to the left outside and to bend forward, thereby preventing the pipe 30 from interfering with other members, such as the hinge 27 and the second support bracket 29, when the air conditioner capacitor

moves to and is in the
10 ~~has an~~ open posture.

In Fig. 11 ~~to Fig.~~ 14, ~~the reference numeral 31 denotes~~ a latching device 31, with a handle 31a provided at the right side of the support member 26. ~~and the reference numeral 32 denotes~~ a latch receiving fixture 32 is provided at ~~the~~ third support bracket 33 fixed to the right side part of the case frame 23 so as to be engageably locked by the latching device 31, thereby ~~allowing~~ holding the air conditioner capacitor 10 ~~to be held~~ at a cooling posture, and, at the same time, allowing an operator to swing the air conditioner capacitor 10 with a light control force.

In the configuration of the fourth exemplary embodiment as described above, the oil cooler 9 and the radiator 8 are arranged side by side and adjacent to each other ~~left and right~~, at the front side of ~~these~~ oil cooler 9 and radiator 8. the turbocharger cooler 11 is placed at the upper ~~side~~ portion and the air conditioner capacitor 10 is placed at the lower ~~side~~ portion of the oil cooler 9 and the radiator 8.

When the cooling device in this configuration is cleaned, the air conditioner capacitor 10 is allowed to be held at an open posture, thereby the rear face side of the air conditioner capacitor 10, and the front face lower halves of the oil cooler 9 and of the radiator 8 are exposed. thus, ~~these~~ parts can be easily cleaned. On the other hand, as described above, provided between the turbocharger cooler 11 and the oil cooler 9 and the radiator 8, is the ~~appropriate~~ space S through which a cleaning worker can visually observe the core section of the cooling devices from the lower part of the turbocharger cooler 11. ~~is secured~~. As a result, the cleaning worker, standing at ground level, can visually observe from the lower ~~direction~~ side the core section

of the cooling device by ~~allowing~~ holding the air conditioner capacitor 10, arranged at the lower side of the turbocharger cooler 11, ~~to be held~~ at ~~an~~ the open posture. ~~thereby allowing~~ Thus, the cooling devices can be cleaned easily without damaging the core section, thus improving workability.

Additionally, in the configuration of the fourth exemplary embodiment, only the air conditioner capacitor 10, among the cooling devices provided at the front side of the oil cooler 9 and the radiator 8, is structured to change ~~the~~ its posture between the cooling posture and the open posture. ~~and~~ The turbocharger cooler 11 is ~~bolted~~ fixed in position. Thus, when repair of the oil cooler 9 and the radiator 8 is performed, the turbocharger cooler 11 ~~is required to~~ must be removed. But in case of a ~~construction~~ work machine, such as a hydraulic shovel, which works at ~~construction~~ a site with lots of dust, cleaning of the cooling devices ~~is required to~~ must be frequently performed. In the fourth exemplary embodiment, the cleaning can be performed without removing the turbocharger cooler 11 while observing the core section.

Further in the fourth exemplary embodiment, the air conditioner capacitor 10, which is arranged at the lower ~~side among~~ portion of the cooling devices, arranged adjacent to each other at the upper and lower ~~sides~~ portions, is structured ~~so as~~ to change ~~the~~ its posture. Thus, by allowing the air conditioner capacitor 10 to be held at an open posture, an operator responsible for cleaning can visually observe the cooling devices appropriate space S between the turbocharger cooler 11 and the oil cooler 9 and the radiator 8 from the lower ~~direction. thereby~~ side. Thus, a cleaning worker can clean the cooling devices from ~~at~~ ground level (or ~~in a condition where a cleaning worker~~ standing on the crawler upper face in the case of a large ~~construction~~ work

machine), avoiding the difficulty ~~trouble~~ such as climbing on the upper face of the upper rotating body 3 to clean the cooling device, thus contributing to improvements in workability.

Further, the ~~present~~ invention can also be adapted to a configuration in which only the air conditioner capacitor is arranged at the front side or at the rear side of the radiator and/or the oil cooler or a configuration in which the air conditioner capacitor and the turbocharger cooler are arranged to be superposed ~~back~~ front and ~~forth~~ rear, for example.

In the second, third and fourth exemplary embodiments, components identical to those in the describing exemplary first embodiment are provided with the same reference numerals.

~~[Industrial Applicability]~~

As described above, a cooling device in a ~~construction~~ work machine according to the ~~present~~ invention can be effectively used for cooling devices, including an oil cooler and a radiator, that ~~is~~ are arranged ~~by~~ in the Back To Back (BTB) or the Side By Side (SBS) methods in a ~~construction~~ work machine, such as a hydraulic shovel. More specifically, the cooling device of the ~~present~~ invention is particularly suitable for cooling devices in which the air conditioner capacitor or the turbocharger cooler is arranged at the front side of the radiator and/or the oil cooler.